GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF RESEARCH ADMINISTRATION

RESEARCH PROJECT INITIATION

Date: 11 September 1972

Project Title: Dental Metallurgy

Project No: E-19-515

Principal Investigator: Dr. R. F. Hochman

Sponsor: Public Health Service, NIH

Agreement Period: From July 1, 1972 Until June 30, 1973

Type Agreement: Grant No. 5 T01 DE00127-10

Amount: $77,377*

* $69,104 in new funds plus $8,273 unexpended balance from the -09 year.

Reports Required:
Statement of Appointment of Trainee
Interim Progress Report
Terminal Progress Report (only if project is not renewed)

Sponsor Contact Person (s):

Dr. Louis J. Pecora
Program Officer
Biomaterials Program
Extramural Programs
National Institute of Dental Research
Bethesda, MD 20014

Assigned to: School of Chemical Engineering

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Patent Coordinator	Other

RA-3 (6-71)

GEORGIA INSTITUTE OF TECHNOLOGY

OFFICE OF RESEARCH ADMINISTRATION

~~RESEARCH~~ Training PROJECT TERMINATION

Date: 15 March 1974

Project Title: Dental Metallurgy

Project No: E-19-515

Principal Investigator: Dr. R. F. Hochman

Sponsor: DHEW/PHS/NIH; Nat. Institute of Dental Research

Effective Termination Date: 9-30-73

Clearance of Accounting Charges: by 9-30-73

Grant Closeout Items Remaining: None*

***Program continued under project E-19-523.**

School of Chemical Engineering

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Terminated Project File No. _____
Other _____

RA-4 (5/70)

E-19-515

GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA. GEORGIA 30332

SCHOOL OF
CHEMICAL ENGINEERING

November 16, 1973

Dr. Louis Wachtel
Acting Chief, Biomaterials Program
Extramural Programs
National Institute of Dental Research
National Institutes of Health
Bethesda, Maryland 20014

Dear Lou:

Attached is my Annual Report for the Training Program DE00127-10. Because of the extension to cover the summer trainees the tenth year was not officially completed until September 30th. I had hoped to have the report to you by November 1st, however, I was hit with the flu and my secretary had an accident so there was an unfortunate delay.

I hope to be in touch with you in the near future to discuss the new guidelines for training and to develop some support for Forest Butler, a recent dental graduate who wants to get a broader background in materials.

Best personal regards.

Very cordially yours,

Robert F. Hochman,
Associate Director for Metallurgy

RFH/hdr

Attachment: 2

P.S. The program we started this past summer, with the dental students, on the bactericidal effect of amalgam components has produced some very interesting results to date.

ANNUAL REPORT ON TRAINING PROGRAM SUPPORTED BY NIDR

I. GRANT INFORMATION DATA

A. Grant Number: De-00127-10

B. Grant Title: Graduate Training in Dental Metallurgy and Materials

C. Institution and School: Georgia Institute of Technology
Engineering College
Metallurgy Program
School of Chemical Engineering

D. Program Director: Robert F. Hochman

E. Reporting Period: July 1, 1972 - September 30, 1973

F. Program Description:

This program is concerned with dental metallurgy and materials training for graduate students, postdoctoral dentists and engineers, and summer training for undergraduate dental students. The training provides an effective interplay between dental and materials oriented personnel. Formal courses, seminars, and dental student and graduate dentist participation in research provides them with basic knowledge of the metallurgy of dental restorative materials. The program also brings other Georgia Tech staff members in engineering and the physical sciences, as well as metallurgy into the academic and research programs of the trainees.

Georgia Tech has initiated expansion and further development of its program in bio-engineering. This training program is one of the foundations of the bio-materials program at the Georgia Institute of Technology.

II. INFORMATION ON TRAINEES

A. Summer Trainees: (students trained during the summer of 1972, and 1973).

Name and Address	Dental School & Class	Stipend	
Bresser, Arthur R. 826-5 Clifton Ct. Cir. Atlanta, Georgia 30329	Emory School of Dentistry Sophmore	$1200.00	1972
Butler, M. F.* 1865 Ridgewood Drive, N.E. Atlanta, Georgia 30307	Emory School of Dentistry Senior	$1200.00 1200.00	1972 1973

II. Section A. (cont.)

Kert, Lesley A. 2057 Renault Lane Atlanta, Georgia 30345	Emory School of Dentistry Junior	$1200.00	1973
Miness, Ira. L. 2298-13 LaVista Road Atlanta, Georgia 30329	Emory School of Dentistry Sophomore	$1200.00	1972
Nelson, Donald B. 209 Bluff Avenue North A Augusta, Georgia	University of Georgia Sophomore and Junior	$ 300.00 $ 300.00	1972 1973
Quinn, Douglass A. 1766 N. Decatur Cottage A Atlanta, Georgia 30307	Emory School of Dentistry Junior and Senior	$1200.00 $1200.00	1972 1973
Sims, Lawrence O. Box 21489 Emory University Atlanta, Georgia 30322	Emory School of Dentistry Junior and Senior	$1200.00 $1200.00	1972 1973
Villastrigo, Arron C. 114 Adobe San Antonio, Texas	University of Texas Dental School - San Antonio Sophomore	$1200.00	1972

The students above marked with an asterisk also spent the 1971 summer on the summer training program at Georgia Tech.

B. Regular Trainees:

1. Trainees who completed training during grant year.

a. Name and permanent mailing address:

Marek, M. Post doctoral completed training in June, 1973. Now a Research Scientist with Georgia Institute of Technology.

Okabe, T. Postdoctoral - completed training in December, 1972. Now a special postdoctoral with the Georgia Institute of Technology.

Villastrigo, A. Completed M. S. in Metallurgy, September, 1972. Now a dental student at University of Texas - San Antonio.

2. Trainees supported during grant year and still in training.

Chien, K. H.
Box 36050
Georgia Tech
Atlanta, Georgia 30332

Heller, C. B.
1231 Clairmont, Apt. 8-C
Decatur, Georgia 30330

Mashaal, M. E.
251 Tenth Street, N. W.
Building 13, Apt. 129
Atlanta, Georgia 30318

b. Degrees held prior to acceptance.

Chien, K. H.	B.S.	Cheng-Kung University Taiwan. 1960
	M.S.	University of Connecticut Storrs, Connecticut. 1970
Heller, C. B.	B.S.	Emory University Atlanta, Georgia. 1971
Mashaal, M. E.	B.S.	Cairo, University Egypt. 1959
	M.S.	Georgia Tech Atlanta, Georgia 1973

c. Degrees Sought.

Chien, K. H. - Ph.D.
Heller, C.B. - M.S. and Ph.D.
Mashaal, M.E. - Ph.D.

3. Brief Narrative of the Research Problem of Each Trainee.

Chein, K. H.

Fatigue of Au-Cu Alloys

An important consideration to development of a more systematic approach to dental gold alloys is the characterization of their mechanical properties. Mr. Chien will study the strain controlled low cycle fatigue of Cu Au single crystals. The fatigue properties, such as the fatigue ductility coefficient and the fatigue strength coefficient, both for ordered and disordered materials will be evaluated. Dislocation configurations will be determined as a function of the ordering and will be correlated with the fatigue properties. A correlation between the long-range order parameters with fatigue properties

Chein, K. H. (cont.)

and fracture characteristics will also be investigated in the hope of developing more consistant Au-Cu alloys.

Heller, C. B.

Bactericidal Effects of Various Dental Amalgam Components

Ms. Heller's program is designed to evaluate the possibilities of the bactericidal effects of various dental amalgam components. The combination of bacterial species common in recurrent caries is grown in soy broth which support their growth. This bacterial culture and broth is then placed in contact with various components and phases of dental amalgam and the rate of bacterial growth, or suppression, is studied. The reason for this study is that often in areas in the marginal space between the amalgam and tooth poor adaptation occurs but very rarely does recurrent caries result. Thus the possibility of certain constituents of dental amalgams may actually be biocidal to the bacteria causing caries. This would be an extremely important consideration and very useful for further application and treatment of dental restorative materials.

Mashaal, M. E.

Evaluation of Volume Fraction of Dental-Amalgam Phases

Mr. Mashall will try to evaluate, using a systematic approach, the various volume fractions of amalgam phases occuring in dental amalgam so that a useful and reproducable technique can be established to study phase changes during the amalgamation process. To date the volume fraction of dental amalgams have been measured using the intergrated intensity of two or more strong peaks in the x-ray diffraction pattern. However, errors are introduced due to preferred orientation, grain size, and other statistical factors. However, a special iterative mathematical analysis can be used to eliminate statistical and systematic errors produced in this analysis. Thus the general program will use x-ray diffraction and then evaluate the resultant patterns mathematically to determine accurately the amount of phases present. Of course, the initial studies have been based primarily on powder mixtures of phases to verify the technique and the mathematical analysis.

Marek, M.

Corrosion of Dental Alloys

Dr. Marek has performed an excellent series of experiments which go well beyond present data available in the corrosion of dental amalgams and dental restorative alloys. He has shown that, contrary to recent publications, the gamma II phase does actually passivate and produces

Marek, M. (cont.)

an insoluble rather than soluble corrosion product. In addition the phase by itself is not greatly corrosion prone but in crevices is highly susceptible. This is important both in the general corrosion aspect of dental amalgams and from the stability or deterioration of margins. Portions of this work have been reported in several journals and at the 1972 and 1973 AIDR meetings.

Okabe, T.

Phase Transformations and Diffusion in Dental Alloys

Dr. Okabe has determined various diffusion rates in the silver-tin, silver-mercury, tin-mercury, and silver-tin-mercury systems. This phenomena, along with the characterization of how the amalgamation occurs, is important to the strength, the corrosion characteristics, and the overall structural integrity of the amalgam. Results of Dr. Okabe's work have been presented in several journals and at the 1972 and 1973 AIDR meetings.

Villastrigo, A. C.

Tarnishing Resistance of Gold Dental Alloys

Mr. Villastrigo's study was performed to elucidate the reactions occurring during the formation of tarnish on dental gold alloys. The tarnishing of dental gold alloys with and without palladium in sodium sulfide solution was investigated by electrochemical methods and microanalysis of the surface films formed during exposure.

The results showed that Cu_2O, CuS, Cu_2S, and Ag_2S were the reactions which could occur on the surface of the gold alloys in the simulated oral environment. Ag_2S was identified by Auger analysis as being the major constituent present in the tarnish film. Polarization curves in deaerated buffer solutions verified the possible formation of Cu_2O on the surface of these alloys. From the polarization curves, CuS and Cu_2S were also observed as possible compounds which could form in a simulated oral environment, but these were not identified in analysis of the tarnish films. The addition of palladium to gold alloys decreases the susceptibility of the alloys to tarnishing. It is suggested that the palladium addition increases the activation energy for the reaction of silver with sulfur. All of the gold alloys showed casting porosity which seemed to increase the susceptibility to tarnishing.

4. Teaching experience on this grant.

Marek, M. - Dr. Marek has provided more than a dozen lectures to the summer dental trainees and has also taught portions of full time courses, over the past year equivalent to approximated 25 hours in various phases of physical metallurgy, dental materials, and corrosion. He has proven an excellent lecturer and provided insight to the participants on some of the fundamental aspects of the metallurgy of dental alloys.

Okabe, T. - Dr. Okabe has provided a series of lectures to the summer dental trainees on the various stages of dental metallurgy and has also given several additional hours of lectures to the staff and students in various phases of research as well as filling in from time to time on physical metallurgy lectures.

Villastrigo, A. C. - Mr. Villastrigo provided a number of lectures to 1972 and 1973 summer dental trainees

Mashaal, M. E. - Mr. Mashaal provided a number of lectures for 1973 summer dental trainees.

5. Amount of funds used for support:

(1) stipend

Chien	$2,600.00
Heller	1,200.00
Mashaal	2,800.00
Marek	7,000.00
Okabe	3,500.00
Villastrigo	1,633.34

(2) dependency allowance

Chien	500.00
Heller	None
Mashaal	1,500.00
Marek	500.00
Okabe	750.00
Villastrigo	None

(3) tuition and fees

Chien	1,892.00
Heller	534.00
Mashaal	712.00
Markek	None
Okabe	None
Villastrigo	1,209.00

Amount of funds used for support (cont.).

(4)	travel funds	Chien	None
		Heller	None
		Mashaal	269.41
		Marek	577.41
		Okabe	434.95
		Villastrigo	None
		Butler	114.00

6. Trainees who withdrew during the reporting year.

NONE Trainees - 3 trainees completed their work and the others are continuing

III. INFORMATION ON FORMER TRAINEES, not supported by funds from the grant year July 1, 1972 - September 30, 1973.

A. Name and permanent address (last available)
B. Degrees held prior to acceptance:

Larry D. Love (M.S. on Program)
Alabama School of Dentistry
1919 7th Avenue, S.
Birmingham, Alabama
DDS - Emory University

Stephen W. Freiman (M.S. on Program)
Materials Research Division
Illinois Institute of Technology Research Center
(Armour Research Institute)
Chicago, Illinois
B.S. in Ch.E. - Georgia Tech

John C. Caron (M.S. on Program)
Address Unknown
B.S. in Ch.E. - Georgia Tech

John W. Koger (M.S. on Program)
Oak Ridge National Laboratories
Materials Division
Oak Ridge, Tennessee
B.S. in Ch.E. - Georgia Tech

Walton E. Horne (M.S. on Program)
Bell Telephone Laboratories
Norcross, Georgia
B.S. in Ch.E. - Georgia Tech

III. (cont.)

Francis J. Topolski
Bell Telephone Laboratories
Norcross, Georgia
B.S. in Ch.E. - Georgia Tech

Evan Ling (Post Doctoral)
Research Scientist
Georgia Tech
Atlanta, Georgia

C. Degree(s) awarded during grant support, year each degree was awarded (if none, so state), and field or discipline.

Villastrigo, A.C. - M.S. in Metallurgy (Dental Materials - August 1972
Love, L. D. - M.S. in Metallurgy (Dental Materials) - June, 1970
Topolski, F. - M.S. in Metallurgy (Dental Materials) - June, 1969
Horne, W. E. - M.S. in Metallurgy (Dental Materials) - March, 1969
Koger, J.W. - M.S. in Metallurgy (Dental Materials) - June, 1967
Caron, J. C. - M.S. in Metallurgy (Dental Materials) - March, 1965
Freiman, S. W. - M.S. in Metallurgy (Dental Materials) - June, 1965

D. Title of thesis or research projects:

Villastrigo, A.C. - "Tarnishing Resistance of Gold Dental Alloys"

Freiman, S. W. - "Diffusion of Mercury Into Silver-Tin Dental Alloy (Ag_3Sn) Including the Effect of Ultrasonic Energy"

Caron, J. C. - "The Effect of High Condensing Pressures and Ultrasonics on the Hardness of Dental Amalgams"

Koger, J. W. - "A Study of the Kinetics of the Mercury Reaction With the Silver-Tin Dental Alloys"

Horne, W. E. - "Order Strengthening in Equiatomic Copper-Gold"

Topolski, F. J. - "The Effect of Ultrasonics on the Physical and Mechanical Properties of Metals"

E. Starting date and completion date for grant support:

Name	Starting date	Completion date
Villastrigo	9/1/69	9/30/72
Love, L. D.	7/1/66	6/30/70
Topolski, F. J.	1/1/67	9/30/68
Horne, W. E.	10/1/66	9/30/68
Koger, J. W.	10/1/63	3/30/65
Caron, J. C.	10/1/65	6/30/67
Freiman, S. W.	10/1/63	6/30/65

III. (cont.)

F. Current position:

Villastrigo, A. C. - Dental Student - University of Texas - San Antonio, Dental School, San Antonio, Texas.

Love, L. D. - Assistant Professor, University of Alabama Dental School - NIDR Fellow in Bio-physics, Birmingham, Alabama.

Freiman, S. W. - Research Scientist with Illinois Institute of Technology where he has participated in programs which have possible dental-medical applications.

Caron, J. C. - Unknown

Koger, J. W. - Research Scientist at Oak Ridge National Laboratories Oak Ridge, Tennessee.

Horne, W. E. - Bell Laboratories, Norcross, Georgia.

Topolski, F. J. - Bell Laboratories, Norcross, Georgia

IV. INFORMATION ON KEY PROFESSIONALS STAFF ON TRAINING PROGRAM

A. Current staff, on training program during reporting period.

1. Name and Degrees:

Hochman, Robert F.
B. S. Met. Engr. 1950 University of Notre Dame
M. S. Met. Engr. 1954 University of Notre Dame
Ph.D. Met. Engr. 1959 University of Notre Dame

Grenga, Helen E.
A. B. Chemistry 1960 Shorter College
Ph.D. Chemistry 1967 University of Virginia

Muzzy, John D.
B. S. Basic Engr. 1963 Princeton University
M. S. Polymer Sci. 1964 Princeton University
Ph.D. Chem. Engr. and Polymer Sci. 1970 Rensselaer Polytechnic Institute

2. Title, rank and department:

Hochman, Robert F.
NIDR Training Grant Director
Professor of Metallurgy
School of Chemical Engineering

IV. (cont.)

Grenga, Helen E.
Technical Assistant to the NIDR Grant Director
Associate Professor
School of Chemical Engineering

Muzzy, John D.
Professor of ChE
Assistant Professor
School of Chemical Engineering

3. Research Area:

Hochman, R. F. Dr. Hochman's work is basically the application and compatibility of materials in dental-medical environments, including the physical metallurgy of corrosion, the effects of ultrasonics on metallurgical phenomena, and evaluation of new materials and their possible application in dental-medical environments.

Grenga, H. E. - Dr. Grenga specializes in electron microscopy, electron diffraction and surface research in metals and their relation to the biological environment. In addition to her background in chemistry, she has also had one year's experience as a bio-chemist research technician at Emory University.

Muzzy, J. D. - Dr. Muzzy specializes in the area of polymer engineering and polymer chemistry. He has worked in the area of adhesives for general applications and is presently responsible for programs of three of the summer dental trainees in the area of polymer and polymer properties for application to dental restorative materials.

4. Total support from the grant in dollars, and per cent of time spent on the grant:

Hochman, R. F. - $9,403 - This represents an average of approximately 30% for the full year.

Grenga, H. E. - $5,547 - This represents an average of approximately 27% of Dr. Grenga's time for a full year.

Muzzy, J. D. - $2,880 - This represents an average of approximately 15% of Dr. Muzzy's time for a full year.

IV. (cont.)

5. Names of trainees, from II, for whom he (she) was preceptor:

Hochman, R. F. - Thesis director for Ms. Heller and Mr. Mashall and director of post doctoral training of M. Marek and T. Okabe. In addition, Dr. Hochman was also the major director of the summer training program for several dental students and specifically directed the programs of: Mr. M. F. Butler, Mr. James Cole, Mr. Charles Mason, Mr. Wesley Burke and Mrs. Leslie Kert.

Grenga, H. E. - Dr. Grenga, although not directly responsible for thesis direction, was actively engaged in post-doctoral training work as well as providing assistance for Mr. A. C. Villastrigo. In addition, Dr. Grenga also provided assistance in special areas of surface and electron microscopy studies for the summer dental trainees.

Muzzy, J. D. - Dr. Muzzy has been providing additional training for graduate student trainees, postdoctorals and dental students in the area of dental polymers. This is in the form of laboratory examples and lectures and in the case of summer dental trainees, Dr. Muzzy has been actively involved in research with Mr. Douglas Quinn, specifically directing his summer training in the area of dental restorative polymers.

6. Did any of these trainees spend time working on a research project not supported by NIDR:

Yes. Mr. Mashaal spent small portions of his time on a special project on composites for medical applications supported by a private company. Total support for the year was approximately $1,000.

7. Names of trainees, from III, for whom he was preceptor:

Hochman, R. F. - Preceptor for Steven W. Freiman, John C. Caron, John W. Koger, Francis J. Topolski, and L. D. Love.

B. Former Preceptor Staff:

1. Name and degrees: (Also 2 and 3 are answered)

Starke, E. A., Jr. - Professor
B. S. - Metallurgical Engineering, 1960, Virginia Polytechnic Institute
M. S. - Metallurgical Engineering, 1961, University of Illinois
Ph.D. - Metallurgical Engineering, 1964, University of Florida
Dr. Starke was preceptor for the work of Mr. Walton E. Horne.

IV (cont.)

LeFevre, B. G. - Associate Professor
B. S. - Metallurgy, 1959, Colorado School of Mines
Ph.D. - Metallurgical Engineering, 1966, University of Florida
Although Dr. LeFevre has not been directly the preceptor of any of the trainees listed in II or III, he has served from time to time to assist all of these students either under partial support from the training grant or on his own institutional time.

V. PUBLICATIONS (with trainee as author or co-author during this period)

1. T. Okabe, F. Ling and R. F. Hochman, "Amalgamation Reaction of Tin, Silver, and Dental Alloy (Ag_3Sn)," Jour. Biomed. Matr. Res. 6, 553 (1972).

2. T. Okabe, R. F. Hochman and M. E. McLain, "Tracer Diffusion of Silver and Tin in A Dental Alloy (Ag_3Sn)" published in the Jour. Biomed. Matr. Res.

3. T. Okabe, R. F. Hochman and L. O. Sims, "Amalgamation Reaction on Mercury-Plated Dental Alloy (Ag_3Sn)", to be submitted to the J. Biomed. Matr. Res.

4. T. Okabe, R. F. Hochman and M. E. McLain, "Kinetic Factors in the Amalgamation of Dental Alloy," presented at the 50th Annual Meeting of the International Association of Dental Research, Las Vegas, Nevada, March, 1972.

5. T. Okabe, R. F. Hochman and L. O. Sims, "Kinetic Studies of Amalgamation on Mercury-Plated Dental Alloy (Ag_3Sn)", presented at the IDAR meeting, Washington D. C., April 1973.

6. M. Marek and R. F. Hochman, "Passivity of Dental Amalgam," paper presented at the TMS-AIME/IMD and ASM/MSD Session, 1972 Materials Engineering Congress, Cleveland, Ohio, 1972.

7. M. Marek, M. F. Butler and R. F. Hochman, "Crevice Corrosion in Dental Amalgam Restorations," paper presented at the 51st Session of the IADR, Washington, D. C., 1973.

8. M. Marek and R. F. Hochman, "The Corrosion Behavior of Dental Amalgam Phases as a Function of Tin Content," paper presented at the 51st Session of the IADR, Washington, D. C., 1973.

9. M. Marek and R. F. Hochman, "A Simulated Crevice Corrosion Experiment for pH and Solution Chemistry Determinations," submitted for publication to Corrosion.

10. D. A. Quinn, W. B. Eames, J. D. Muzzy and R. F. Hochman, "Inhibition of Dentin Discoloration from Silver Amalgam by Copalite Liners," presented at the IADR meeting, Washington, D. C., April, 1973.

VI. OTHER INFORMATION

During the past year several interesting and useful contributions have been made in the area of dental restorative materials and in the training of physical science students and summer dental trainees. For example the work of Dr. Marek has produced significant results in the area of crevice corrosion of dental amalgam. His work has shown that basically dental amalgam is passive in the mouth with the exception of crevice areas, due either to porosity or at dental margins, where the gamma two phase can be attacked when highly localized conditions produce variations in the environment sufficient to produce an active solution for corrosive attack. At other points the amalgam in general is corrosion resistant and gamma two phase has been found in dental amalgams on exposed occusal surfaces after fifteen to twenty years exposure to the oral environment.

An interesting combined study on the effects of copalite is underway between Georgia Tech and Emory University involving summer dental trainees. The original portion of this work was reported at the 1973 IADR Meeting and a portion of it, performed by Mr. Douglas Quinn, a summer dental trainee, resulted in his winning the regional Table Clinic Research Award and he was requested to present his work at the National ADA Meeting in Houston in the Fall of 1973.

The two interesting facts resulting from this study are: (A) Tin from corrosion of the amalgam is actually absorbed in the structure of the copalite varnish and precludes the diffusion of further tin into the tooth structure, hence discoloration is inhibited. (B) It has also been found that this takes place in an extremely short period of time and appears to be related to the very high corrosion current which occurs in the first few minutes of the implantation of the amalgam. The tin pickup is sufficient to stop diffusion through the copalite after one hour exposure to amalgam. Thus, the basic use of varnishes of this type can inhibit corrosion and discoloration as shown scientifically. These results can be an important consideration in placing dental amalgam restorations.

Another interesting study which has been initiated with summer dental trainees and trainees on the program has been the posibility of the biocidal effect of amalgam constituents on dental caries. The various species of bacteria which have been found in areas of dental caries have been produced in various media, in which they normally grow and are now being exposed and analyzed against various phases and components of dental amalgam. The reason for such a study is the indication that even though poor margins leak, deterioration of the amalgam occurs, and discoloration of tooth

structure results very rarely does recurrent caries occur at these marginal areas. Thus the prospect of one or more components of dental amalgam may act as a biocidal agent to caries producing bacteria. If this is correct then it is important that we know what the agent is and how to successfully apply this useful fact, not only in amalgam restorations, but in possible applications to other caries prevention treatment.

In addition to this scientific contribution, former trainees are also active. Mr. Aaron Villastrigo has just completed his first year as a dental student at the University of Texas at San Antonio, Dr. Larry Love is an Associate Professor and Special Research Fellow at the University of Alabama and that Dr. Steven Fred, a former summer dental trainee, is now a Research Scientist at the NIDR. In addition to this two post doctorals actively involved in the program, Dr. Marek and Dr. Okabe, have made significant contributions to the overall study of dental materials and both are members of the staff here at Georgia Tech and plan to continue working in this area as well as other bio-material problems. In fact, Dr. Marek has already designed and worked with a local dentist on a dental implant which has achieved early singular success.

Respectfully submitted,

Dr. Robert F. Hochman,
Program Director, Professor and
Associate Director for Metallurgy
School of Chemical Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

RFH/hdr